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Evaluation of Insect and Disease Conditions in the Kelso Timber Sale Area Following a Fall Prescribed Burn, Greenhorn Ranger District, Sequoia National Forest

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Background

The Revised Kelso Timber Sale is located on the eastern side of the Piute Mountains on the Greenhorn Ranger District in Kern County. The Decision Notice and Finding of No Significant Impact was issued March 28, 1998. Vegetation management activities to be implemented in the Kelso sale included commercial thinning of about 330 acres of Jeffrey pine and mixed conifer stands and precommercial thinning of approximately 90 acres through a commercial fuelwood sale. The activity fuels resulting from the commercial thinning operations were to be treated with prescribed fire through jackpot burning. Jackpot burning is a prescribed burning technique where the heavier concentrations of fuels are ignited in place and allowed to burn. Under prescribed conditions, fire intensities should be lower and fire less likely to spread or spot when it reaches areas of little or no fuels. The stands were thinned during the winter and spring of 1999 with operations completed by June 29, 1999. The jackpot burning was initiated on November 27 and 28, 1999 and completed in early December.

On May 18, 2000, Kathy Roche and Ray Huber, Timber Management Staff, Greenhorn Ranger District, Fred Roach, Fire Management Officer, Greenhorn Ranger District and John Pronos, Plant Pathologist and John Wenz, Entomologist, Forest Pest Management (FPM) South Sierra Service Area, visited some of the thinned/ prescribed burn units on the Kelso Timber Sale. The purpose of the visit was to (1) evaluate insect and disease conditions following the treatments

and (2), provide pest management input for use in planning and implementing future thinning and prescribed burn operations.

Observations

Commercial thinning Units 18, 45 and 2 were visited. Unit 18 is a Jeffrey pine stand (J3N strata) covering 50 acres. The burn appeared to have been a relatively low intensity fire that consumed much of the litter and duff layers. Very little crown scorch and light to moderate bark scorch was observed. Bark scorch up to 5 or 6 feet on the bole was present in scattered, small groups, of trees. The unit was whole tree yarded and consequently, there were relatively small accumulations of woody material on the site. No evidence of bark or engraver beetle activity or insect-related mortality was observed, nor was there any obvious killed cambium at the base of trees.

Unit 45 (86 acres) and Unit 2 (64 acres) are mixed conifer stands (M3N strata) with Jeffrey and ponderosa pine and a few white fir in the overstory and primarily white fir in the understory. In general, there was very little crown scorch in these units and bark scorch tended to be within the limits considered acceptable for the burns. In a few locations, the bark at the base of a few large pines (20 inches DBH) had been severely burned, the surrounding litter/duff layer completely consumed, and it appeared that some cambium had been killed. Red turpentine beetle, *Dendroctonus valens* (See Biology of Pest Organisms, below), attacks were observed at the base of a few pines, particularly in Unit 2. No other evidence of fire-induced insect activity was noted.

Large white fir stumps containing old *Heterobasidion annosum* (the fungus that causes annosus root disease) conks were found in both Units 45 and 2. The stumps dated back to previous logging done 20 or more years ago. None of the conks were still alive and capable of producing spores. In general, stumps were uncommon in all of the sites visited, indicating that the stands have not been heavily or frequently logged in the past few decades and the amount of annosus root disease in the stands appears light.

Discussion

1) Although no fire-induced insect-related tree mortality was observed and only low levels of red turpentine beetle activity were found, it is premature to conclude that no such effects will occur over the next year or two. The burn was conducted in late-November, early-December, 1999, a time when bark and engraver beetle activity is generally low (although the fall and early winter of 1999 was unusually dry and warm). In addition, this evaluation was conducted in mid-May, most likely prior to the peak flight/activity periods of the bark and engraver beetles, which usually occur during the summer and early fall of. Depending on the degree of fire-injury, resulting stand conditions, weather and bark beetle population dynamics, insect activity in response to a burn can occur over a period of time in the years immediately following the burn. The effects of varying levels of fire-induced cambium damage on individual trees may not become evident right after the burn, particularly if the cambium injury is sub-lethal and results in stress that predisposes the affected trees to subsequent bark and/or engraver beetle attack. It will

be important to monitor the burned units for at least 1 to 2 years to evaluate potential effects of the burn on insect-related activity and impacts.

2) The fact that very little insect activity occurred immediately after the November/ December burn, even with a relatively warm, dry, fall, suggests that burning at this time of year may help minimize bark and engraver-related problems. At the same time, the amount of activity fuels resulting from the commercial thinning operations in the Kelso Timber Sale was low due to whole tree yarding that left very little woody material on site. Prescribed burns conducted in areas with heavier accumulations of activity fuels left on the site and/or with a higher pre-existing fuel load, would tend to burn hotter and have an increased likelihood of causing tree injury and predisposition of trees to attack by bark and engraver beetles.

3) The silvicultural prescription for the Kelso Timber Sale called for thinning the stands to improve growth and reduce the probability of bark beetle attacks. The thinning prescription met the requirements of the California Spotted Owl (CASPO) Interim Guidelines. Under the prescription, stocking levels were to be reduced to 55% of the stocking density that would be found in unmanaged stands of similar age (USDA Forest Service, 1997). For the J3N strata, the basal area would be reduced from 173 sq.ft./ac to 149 sq.ft./ac, for M3N, 213 sq.ft./ac to 167 sq.ft./ac and for M4N, 242 sq.ft./ac to 202 sq.ft./ac. The Stand Density Index (SDI) would be reduced to from 301 to 253 for J3N, from 323 to 247 for M3N and from 353 to 323 for M4N. According to Oliver (1995), bark beetle mortality in even-aged ponderosa pine stands in the Sierra Nevada begins to become important at about SDI 230 ("zone of imminent bark beetle mortality") and at SDI 365, stands usually suffer high levels of bark beetle mortality such that "losses equal or exceed periodic growth". Recognizing that there may be differences in the SDI level for the "zone of imminent bark beetle mortality" depending on a variety of factors including species composition and stand structure, the SDI levels targeted by the Kelso thinning operations are above the SDI 230 threshold for even-aged Sierra Nevada ponderosa pine stands and these stands may need to be entered more frequently than desired to maintain stocking at levels likely to prevent bark beetle-related mortality.

4. Of primary concern, from a disease standpoint, is when trees survive a fire but the fire kills a portion of the bole's cambium. This type of injury is normally worst at the base of a tree but may extend up the bole for many feet, depending on the intensity of the fire. Once the cambium is killed all the tree's natural defenses toward pathogens are lost and the wood behind the dead cambium is subject to infection by many different decay fungi. Once heart rots, root rots or sap rots are established, they will continue to decay wood and cause a net loss of sound wood volume.

Heterobasidion annosum is a decay fungus, and while it most commonly enters root systems through freshly cut stump surfaces, it also has the ability to enter through fire scars. (Refer to the end of this report for a description of this pathogen's biology.) We know that this fungus is present in some of the burn units and seems to be affecting the fir component rather than the pine. Currently the level of annosus root disease appears light, presumably because these stands have not been frequently logged. Sporax is used to protect recently cut stump tops from being colonized by *H. annosum*, but there is no practical and effective way to treat fire scars. The District should continue to consider the treatment of both fir and pine stumps with Sporax in

future stand entries. The only way to prevent annosus root disease from entering fire scars is to eliminate or reduce prescribed fires intense enough to cause cambium death.

In many areas of California it has become standard procedure to treat freshly cut stumps with Sporax, especially pine stumps in eastside stands. Treatment of true fir stumps is less common even though Sporax is equally effective in protecting both pine and fir stump surfaces. The exact locations and spatial extent of disease centers in true fir can be difficult to assess because the pathogen often causes decay of the roots and butt log without actually killing the fir or causing obvious above-ground symptoms. Therefore it is more difficult to determine the effect of annosus root disease in true fir, and to economically justify the use of Sporax. For a more detailed discussion of this disease refer to FSH 3409.11 – FOREST PEST MANAGEMENT HANDBOOK, R5 Supplement No. 3409.11-94-1, dated May 17, 1994.

Biology of Pest Organisms

Red Turpentine Beetle

The red turpentine beetle, *Dendroctonus valens* (Coleoptera: Scolytidae), occurs throughout pine forests in North America (except the southeastern part of the United States)and attacks all species of pine within its range. The red turpentine beetle is attracted by the odor of tree pitch or resin. It usually attacks injured, weakened or dying trees and freshly cut stumps. Ponderosa pines infected with black stain root disease have been shown to be particularly susceptible to attack and evidence of red turpentine beetle attack may be an indicator of the presence of the disease. Pines injured by wildfire or prescribed burns are also susceptible to red turpentine beetle attack. Most trees attacked by the red turpentine beetle do not necessarily die, but the attacks may indicate that the tree is under stress. Red turpentine beetle attacks may predispose trees to attack by more aggressive bark beetles like the western and mountain pine beetles.

The red turpentine beetle generally completes one generation per year. In the southern part of its range there may be a partial second generation and in the northern areas, it may take more than one year to complete a life cycle. Adult flight usually occurs between May and October although in the warmer parts of its range it can fly at any time. Attacks usually occur in the basal section of the bole within 6 to 12 inches of the ground, often at the soil line or root crown. They are characterized by large, reddish, pitch tubes near the point of entry and are generally found on only part of the bole circumference. On severely stressed trees (e.g., moisture stress, fire injury, root disease), attacks may extend up the bole to a height of 12 feet or more, and often affect the entire bole circumference.

Adults range in size from 5.3 to 8.3 mm and are generally considered to be the largest of the western bark beetles. If an attack is successful, the adults excavate an irregular, often cave-like, gallery in the cambium. The female lays eggs along the sides of the gallery in groups of 10 to 40 that are loosely packed with frass. The larvae feed in a mass (rather than in individual, discrete,

larval galleries) and can destroy large contiguous areas of cambium. Both larvae and adults overwinter.

Annosus Root Disease In True Fir

Heterobasidion annosum (formerly *Fomes annosus*) is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone and a few brush species (*Arctostaphylos* spp. and *Artemisia tridentata*) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all the National Forests in California, with incidence particularly high in true fir stands that have been repeatedly logged. Disease frequency tends to be higher in older, larger fir stands and in stands with high basal areas (over about 330 square feet/acre).

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, and rarely under the duff at the root collar. New infection centers begin by aerial spread of spores produced by the conks and subsequent colonization of freshly cut stump surfaces or wounds on living trees. The fungus then spreads through root contacts into the root systems of adjacent live true fir. Local spread of the fungus from a stump typically results in the formation of a disease center, with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach natural barriers such as stand openings or non-susceptible plants.

In pines, *H. annosum* grows through root cambial tissue to the root crown where it girdles and kills the trees. In less resinous species such as true firs, the fungus sometimes kills trees, but more frequently it is confined to the heartwood and inner sapwood of the larger roots where it causes a chronic butt and root decay and growth loss. Thus, while infection in true fir usually does not kill the host, it does affect its growth and thriftiness. Losses in true fir from *H. annosum* are mainly the result of windthrow because of root decay, and reduced root systems that predispose trees to attack and eventual death by the fir engraver beetle. Field observations suggest that vigorous young firs are usually able to regenerate root tissues faster than they are lost to the root disease. But when true firs slow in growth because of stand and/or site conditions, root development decreases to where there is a net loss in roots and the trees slowly decline due to the gradual loss of their root systems. This decline may take 10 to 20 years before tree death occurs.

There are two pathogenic strains of the fungus that differ in their ability to infect various conifers in California. The "P" or pine type infects and kills all pines (although susceptibility of pine species vary), in addition to incense-cedar and western juniper. The "S" or fir type infects true fir, Douglas fir and giant sequoia. Knowing which type is active in a stand is important, and will allow favoring alternate conifer species because the fungus strains do not cross infect between the two groups listed above.

Literature Cited

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